# An Experimental Study and Numerical Simulation by RELAP5 for the Downcomer Boiling of APR1400 under LBLOCA

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## Abstract

The direct vessel injection (DVI) mode of a safety injection system is adopted instead of a conventional cold leg injection (CLI) mode as one of the advanced design features of the APR1400 (Advanced Power Reactor 1400 MW). From the calculation results of RELAP5 with full plant, it is found out that the sudden boiling happens in the downcomer due to heat transfer from the reactor vessel wall and it can affect the reactor safety. In the present study, experimental tests are carried out to observe the actual boiling phenomena in the downcomer and to validate RELAP5. The heated wall of test section has its thickness of 8.2 cm and the same material as the prototype (APR1400) with chrome coating against rusting. From the experiment, we visually observe the vapor jetting near the heated wall with small bubble migration to the bulk region and liquid circulation. The data shows a rapid wall temperature drop generating a large amount of vapor initially. The calculation results of RELAP5 using the three nodal schemes are compared with experimental ones in aspects of water level, void fraction, wall temperatures and phase velocities. It turns out that the double nodal scheme with circulation produces better results than the nodal scheme without circulation to simulate the boiling phenomena in the downcomer. And more, from the measurement of local liquid velocities, the proper gap size is proposed and RELAP5 calculation with it is performed.